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Mapping of reporting guidance for systematic reviews and meta-analyses generated a comprehensive item bank for future reporting guidelines

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Abstract

Objectives: To generate a comprehensive bank of systematic review (SR) reporting items to inform an update of the PRISMA 2009 statement.

Methods: We searched the EQUATOR Network library in May 2019 to identify all reporting guidelines for SRs that were published after 2009, regardless of the scope of the guideline. We also conducted a selective review of four guidance manuals for SRs, three tools for assessing risk of bias in SRs, six meta-research studies evaluating the reporting quality of SRs using a tailored checklist, and five reporting guidelines for other study designs. One author screened and selected sources for inclusion, extracted reporting guidance from sources, and mapped guidance against the PRISMA 2009 checklist items.

Results: We included 60 sources providing guidance on reporting of SRs and meta-analyses. From these, we collated a list of 221 unique reporting items. Items were categorised into title (four items), abstract (10 items), introduction (12 items), methods (111 items), results (61 items), discussion (12 items), funding and conflicts of interest (4 items), administrative information (3 items), and data availability (4 items). This exercise generated 175 reporting items that could be added to the guidance in the PRISMA 2009 statement.

Conclusions: Generation of a comprehensive item bank through review and mapping of the literature facilitates identification of missing items, and those needing modification, which may not otherwise be identified by the guideline development team or from other activities commonly used to develop reporting guidelines.

1. Background

The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement is a reporting guideline designed to help authors prepare a transparent and reproducible account of a systematic review (SR) (1, 2). It focuses primarily on SRs and meta-analyses of studies that evaluate healthcare interventions but can also be used as a basis for reporting SRs of other types of research. The PRISMA statement was published simultaneously in 2009 in multiple medical journals (*Annals of Internal Medicine (3)*, *BMJ (4)*, *Journal of Clinical Epidemiology (5)*, and *PLoS Medicine (1)*). An 'explanation and elaboration' paper was also published concurrently in these four journals (2, 6-8), providing detailed guidance for each item along with examples of exemplary reporting found in the literature. The PRISMA statement has been adopted widely by authors and journals, as evidenced through citations (more than 30,000 times (Scopus, June 2019)) and endorsement by more than 400 journals.

There have been many methodological developments affecting SR conduct and reporting in the 10 years since PRISMA was published. These developments include novel guidance on how to identify studies for inclusion (9-11), synthesise and present findings when meta-analysis is not possible or appropriate (12, 13), report and synthesise intervention characteristics of included studies (14, 15), and enhance the reproducibility of meta-analytic results (16, 17). There have also been improvements in the understanding of sources of bias and methodological quality in SRs, culminating in the development of the Risk Of Bias In Systematic reviews (ROBIS) (18) and AMSTAR-2 (19) tools. In December 2017, we initiated a project to update the PRISMA statement to incorporate new items and guidance arising from these and other methodological developments.

In the EQUATOR (Enhancing the QUAlity and Transparency Of health Research) Network's guidance for developers and updaters of health research reporting guidelines, Moher et al. recommend that initial steps should include (a) seeking evidence on the quality of reporting in published research articles and (b) identifying previous relevant reporting guidance for such studies (20). Page et al. recently addressed step (a) in this process, by conducting several evaluations of the reporting quality of published SRs (21-24). However, there has been no attempt to comprehensively identify items from other reporting guidance for SRs and map these against items recommended in the PRISMA 2009 statement. Doing so could help reveal what (if any) items are currently missing from the PRISMA 2009 statement, and provide a useful item bank for those seeking to generate reporting guidelines for types of SRs and meta-analyses that fall outside the scope of PRISMA 2009 (e.g. SRs in disciplines other than health), or those wishing to update existing reporting guidelines for SRs. The aim of this study therefore was to generate a comprehensive bank of SR reporting items to inform an update of the PRISMA 2009 statement.

2. Methods

We registered the PRISMA update with the EQUATOR Network website in December 2017 (http://www.equator-network.org/library/reporting-guidelines-under-development/#86), and our study protocol was registered with the Open Science Framework in February 2018 (25).

2.1. Search and selection of articles

We performed several tasks to identify reporting guidance for SRs. On March 1, 2018, one author (MJP) screened the titles of all 398 reporting guidelines listed in the publicly available library maintained by the EQUATOR Network (http://www.equator-network.org/reporting-guidelines/). The library was checked again on 31 May 2019; by that time, 413 guidelines were available. From this list we included all PRISMA extensions and other reporting guidelines for SRs and other evidence syntheses published after 2009 (when PRISMA was published), regardless of the scope of the guideline (e.g. any discipline or type of included studies). The same author also sought reporting guidance that was available in four manuals for SRs of healthcare interventions (the 2011 Cochrane

Handbook for Systematic Reviews of Interventions (26), the 2011 US Institute of Medicine's Standards for Systematic Reviews (27), the 2014 US Agency for Healthcare Research and Quality (AHRQ) Methods Guide for Effectiveness and Comparative Effectiveness Reviews (28) and the 2017 Joanna Briggs Institute Reviewers Manual (29)).

The same author also reviewed items included in three recently developed critical appraisal tools for assessing risk of bias or methodological quality in SRs (the tool to assess the quality of a meta-analysis developed by Higgins et al. (30), the ROBIS tool (18), and AMSTAR-2 (19)). Six meta-research studies (21, 23, 24, 31-33) in the lead author's personal collection which included an evaluation of the reporting quality of SRs using a tailored reporting checklist were also reviewed. Five key reporting guidelines for other study designs published after 2009 (e.g. CONSORT 2010 (34), SPIRIT 2013 (35), STARD 2015 (36), the 2015 TOP guidelines (37) and the 2017 guidelines for the content of statistical analysis plans in clinical trials (38)) were reviewed to identify general items that could potentially be added to the PRISMA statement, and to improve consistency of wording and style with other reporting guidelines. The list of sources identified was sent to all co-authors, who were invited to suggest additional sources to review.

We also conducted a systematic search for published comments on, or suggested revisions to, the PRISMA 2009 statement. One author (MJP) searched for potentially relevant articles indexed in MEDLINE® (specifically, Ovid MEDLINE® Epub Ahead of Print, In-Process & Other Non-Indexed Citations; Ovid MEDLINE® Daily; and Ovid MEDLINE and Versions®) from inception to 31 July 2017 (the same search was used to identify studies evaluating the reporting quality of published SRs, as summarised by Page and Moher (22)). The following search strategy was used to retrieve articles that included the term "PRISMA" (abbreviated or spelled out in full) in the title or abstract of the article:

1. "Preferred Reporting Items for Systematic reviews and Meta-analyses".ti,ab.
2. PRISMA.ti,ab.
3. 1 or 2.

One author (MJP) screened all titles and abstracts yielded from the searches, and any full text articles considered potentially relevant.

2.2. Compiling of reporting items

From all the included sources, one author (MJP) extracted all guidance that they deemed potentially relevant to the reporting of SRs and meta-analyses of interventions. Guidance for *conduct* of SRs and meta-analyses (e.g. "Search appropriate national, regional and subject-specific bibliographic databases" (39)) was not extracted. Reporting guidelines for SRs were reviewed in chronological order (from oldest to newest), starting with the PRISMA 2009 statement, followed by each of its extensions, and then other sources (the order in which sources were reviewed is shown in Table S1 in the Appendix). Reporting guidance was extracted verbatim from both the checklist and 'explanation and elaboration' paper (where available) for each included reporting guideline.

Reporting items were extracted into a table created in Microsoft Word, with one column for the reporting item and another for the source of the text extracted; each row in the table represented a single reporting item. The table was populated initially with each of the PRISMA 2009 checklist items and any corresponding reporting guidance found in the PRISMA 2009 'explanation and elaboration' paper. This resulted in an initial list of 46 reporting items (19 of the 27 PRISMA 2009 checklist items had additional reporting guidance in the 'explanation and elaboration' paper whereas the following eight items did not: 2, 4, 15, 18, 19, 24, 25 and 26). The table was then populated by recording from other sources all relevant reporting guidance that differed in any way from what was previously extracted. For example, item 5 of the PRISMA 2009 checklist recommends that authors "Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide

registration information including registration number" (1). The corresponding item in the PRISMA extension for diagnostic test accuracy (DTA) studies recommends that authors "Indicate *where the* review protocol can be accessed (e.g., Web address) *and provide registration number if available*" (40) (emphasis added). Both items were extracted in this instance given that the wording is slightly different.

We did not extract items that apply only to specific types or aspects of SRs (e.g. items relevant only to DTA SRs, or child-relevant SRs). Once all PRISMA extensions were reviewed, all reporting guidelines for SRs produced by other organisations/authors, other guidance documents (e.g. SR handbooks), critical appraisal tools and other included articles were reviewed in a similar way to identify additional reporting items not captured from PRISMA 2009 or its extensions. The iterative process used meant that each time a new source was reviewed, items already extracted were revisited to determine whether the new source contained unique reporting guidance. After reviewing all sources, each source was reviewed a second time in the same order by the sole data extractor (MJP) to minimise the chance of missing relevant items.

Once all sources had been reviewed twice, one author (MJP) read the reporting guidance extracted from all sources and compiled a list of unique reporting items. This was done by comparing and contrasting the text extracted and removing any guidance deemed redundant (i.e. covering the same conceptual or methodological issue). The final list of unique items was structured by presenting each PRISMA 2009 checklist item (1) and corresponding guidance from the 'explanation and elaboration' paper (2), followed by any additional reporting guidance relevant to that item not included in these two sources. For some of the items presented in the list of unique reporting items, we changed the wording from the original source to make it more applicable to SRs of interventions, or broke a comprehensive item into multiple sub-items to facilitate clarity.

We counted the number of unique reporting items across all included sources and the number of items not currently included in the 27 sections of the PRISMA 2009 checklist and 'explanation and elaboration' paper that could potentially be added in the update of the guideline.

2.3. Deviations from the protocol

We planned to conduct a formal systematic search for methodological studies (or SRs thereof) that provide guidance on how to conduct or report SRs and meta-analyses (25). We intended to do this by searching MEDLINE® and Embase, adapting the search strategy used by McGrath et al. to identify literature to inform the development of the PRISMA-DTA extension (41). However, formal searching in March 2018 proved difficult and resulted in a very large number of records (>46,000) to screen, very few of which we assumed would be relevant. Therefore, we did not carry out this planned step in our process.

3. Results

We reviewed 60 sources (presented in 56 reports) that provided reporting guidance for SRs and meta-analyses (1, 2, 14, 15, 17-19, 21, 23, 24, 26-38, 40-72) (included reports are listed in Table S1 in the Appendix, also available at https://osf.io/kbj6v/). Half (n=30) of the sources were published in 2016 or later. Included sources were: the PRISMA 2009 statement and all of its published extensions (both the checklist and 'explanation and elaboration' for each were reviewed), 26 other sources providing reporting guidance for SRs (including other reporting guidelines and SR manuals), three tools for assessing risk of bias or methodological quality in SRs, six studies that evaluated the reporting quality of SRs using a tailored reporting checklist, and five reporting guidelines for other study designs.

The search of MEDLINE® for published comments on, or suggested revisions to, the PRISMA 2009 statement, yielded 5,001 citations. After screening each title and abstract, the full text of 170 articles was retrieved, and 43 met the inclusion criteria (listed in Table S2 in the Appendix, also available at https://osf.io/kbj6v/). However, none of the 43 articles contained any additional relevant reporting items which had not already been identified from the 60 sources described above, so are not discussed further.

A total of 349 reporting items were extracted from the 60 sources (Figure 1). After comparing and contrasting the items to check for redundancy, we compiled a list of 221 unique reporting items deemed relevant to SRs and meta-analyses of interventions (Table S3 in the Appendix, also available at https://osf.io/kbj6v/; the complete list of 349 items extracted verbatim from each source is presented in Table S4 in the Appendix, also available at https://osf.io/kbj6v/). We categorised the 221 unique reporting items into the following broad categories: title (four items), abstract (10 items), introduction (12 items), methods (111 items), results (61 items), discussion (12 items), funding and conflicts of interest (four items), administrative information (three items), and data availability (four items).

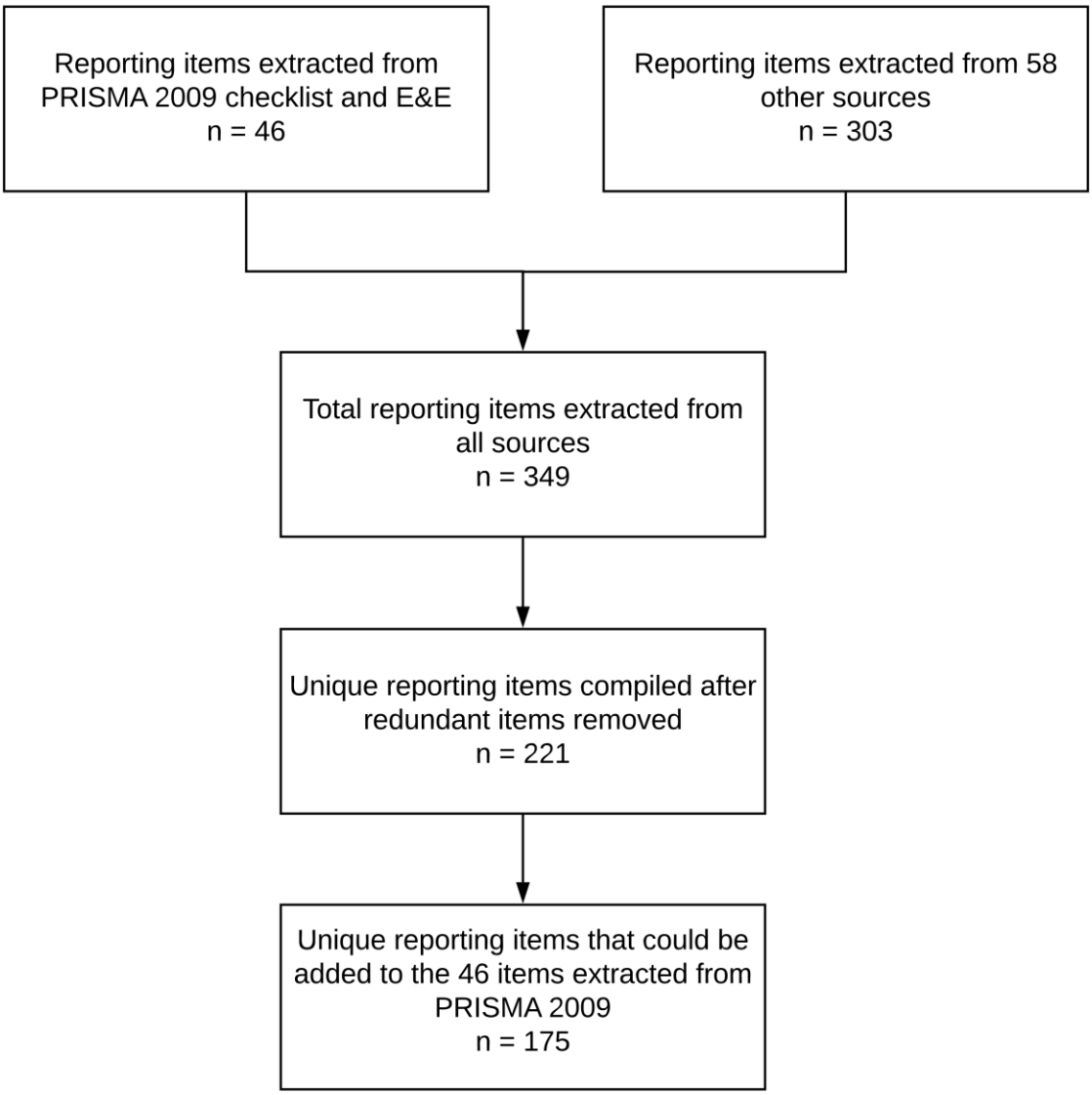

Figure 1. Flow diagram of extraction and compilation of reporting items. "E&E" = explanation and elaboration paper.

There was at least one new relevant reporting item that could be added to the 46 items extracted from the 27 sections of the PRISMA 2009 checklist and 'explanation and elaboration' paper (1, 2). In total, 175 additional items were compiled (168 items were relevant to the 27 sections of PRISMA 2009 (Figure 2) and seven items were not captured by PRISMA 2009). The sections of PRISMA 2009 with the highest number of additional items compiled were:

- methods for synthesizing results (18 additional items, for example, more detail about the statistical methods for meta-analysis used, descriptions of synthesis or summary methods used when meta-analysis was not possible or appropriate);
- results of the synthesis (14 additional items, for example, more detail about what information to report for each result, such as an effect estimate, confidence interval, prediction interval (when appropriate) and a description of the direction of the effect);
- study characteristics (13 additional items, for example, a comprehensive summary of the intervention details for each study, conflicts of interest of study authors, and sources of funding for each study);

- information sources (12 additional items, for example, more detail about the particular reference lists examined, journals hand searched, and researchers contacted to identify studies, and whether any update to searches was undertaken during the conduct of the review); and
- data items collected (12 additional items, for example, defining in detail all outcomes and data collection of potential effect modifiers).

The seven additional items that do not map to the PRISMA 2009 statement address administrative information (e.g. affiliations and contributions of authors) and data availability (e.g. making data sets and statistical analysis code available).

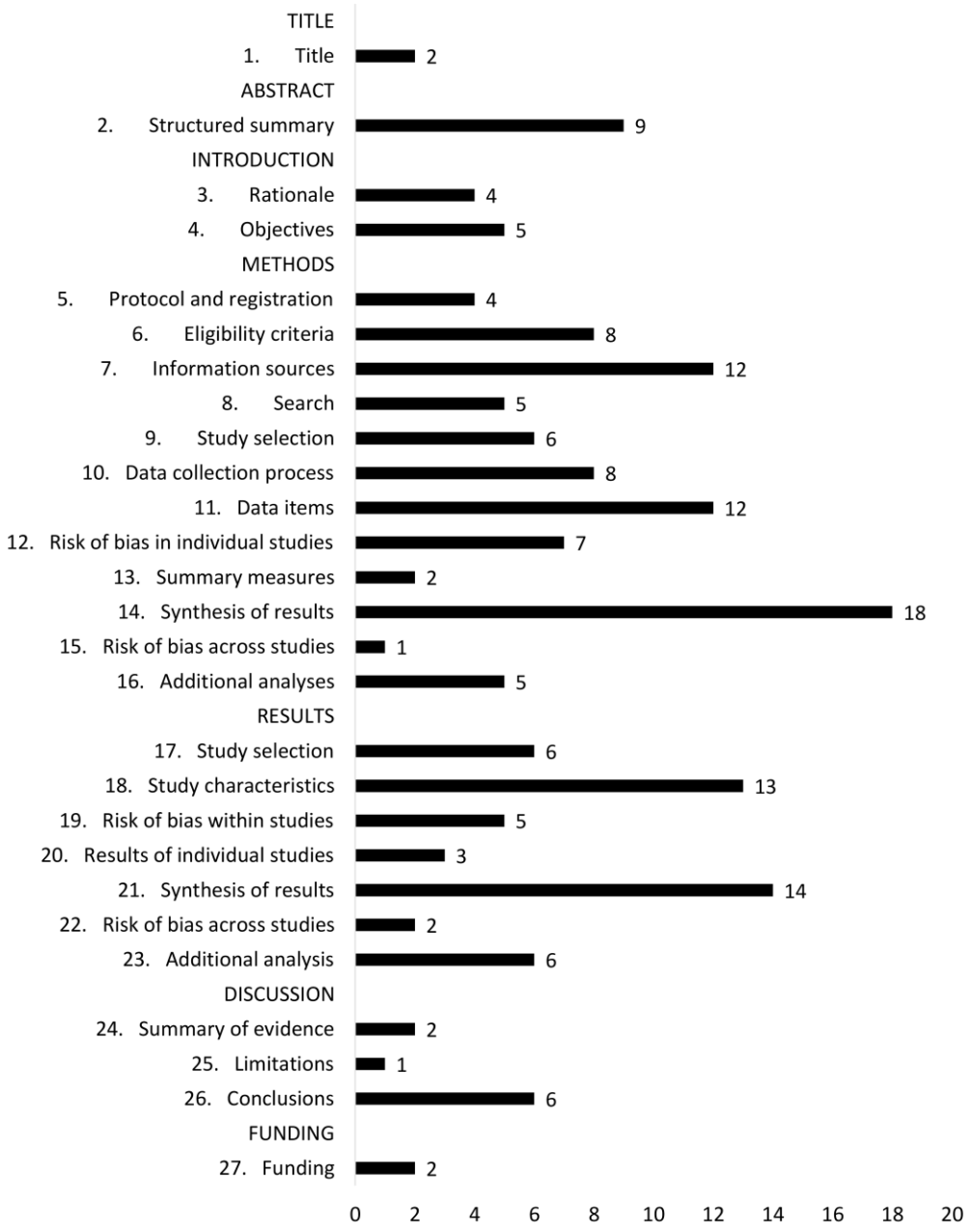

Figure 2. Number of additional items relevant to the 27 sections of the PRISMA 2009 statement that were compiled from other sources but not included in the PRISMA 2009 checklist or 'explanation and elaboration' paper (see Table S3 in the Appendix for complete list of items)

In the 60 sources from which we collated reporting items, four included a proposal for an alternative PRISMA flow diagram of the identification, screening and inclusion of studies (60, 67, 69, 72). Proposals included: the addition of a text box indicating the number of studies included in a previous version of the review (for SR updates) (60); separate flow diagrams for different information sources (e.g. one for bibliographic databases, another for trials registers) (69); modifications to the formatting within and layout of text boxes (67); and the addition of text boxes indicating the number of irretrievable full texts, pre-screened articles from other sources, and studies not included in the synthesis, with reasons (72).

4. Discussion

Based on a selective search for existing guidance on the reporting of SRs and meta-analyses, we compiled a list of 221 reporting items of potential relevance to SRs and meta-analyses of interventions. Most of the items (n=111) apply to the methods section of a SR, with information about the information sources consulted, data items collected, and methods for synthesizing results used being the most common. This review generated 175 reporting items that could potentially be added in an update of the guidance in the PRISMA 2009 statement, including modifications to existing items and addition of new items.

A major strength of this research is the inclusion of multiple sources of guidance for SRs and meta-analyses, regardless of the discipline from which they originated (e.g. medicine, psychology, or environmental research) or the type of synthesis to which the guidance applies (e.g. SRs of intervention studies or SRs of DTA studies). Doing so resulted in an extensive set of potential reporting items for consideration. As the majority of sources were published from 2015 onwards, they should provide guidance that is relevant to current SRs.

Our findings should be interpreted in light of some limitations. We did not seek the rationale for or evidence underpinning each item extracted (as described by the authors/guideline developers). Therefore, readers should consider the current list of reporting items in Table S3 in the Appendix as possible contenders for inclusion in the updated PRISMA statement, since items have not been ranked in terms of priority for reporting. Also, the selection of sources, extraction of items from sources, and compiling of items was performed by one author only, so it is possible that additional sources and items would have been identified had another author undertaken this exercise. However, the author reviewed each source twice, which likely minimised the chance of missing relevant items.

To our knowledge, this is the first attempt to map the content of other reporting guidance for SRs and meta-analyses against items recommended in the PRISMA 2009 statement. The most similar exercise that we are aware of was that conducted by McGrath et al. in preparation for the PRISMA-DTA extension (41). The authors systematically searched methodological literature on SRs of diagnostic test accuracy and identified 19 unique sources from which they compiled a list of 64 reporting items. All the items identified by McGrath et al. that are relevant to SRs of interventions were identified in our search also. That more sources (n=60) and items (n=221) were identified in our study likely reflects the greater attention that SR methodologists have devoted to SRs of interventions.

The large number of reporting items not captured in PRISMA 2009 that this exercise generated illustrates the value of systematically mapping reporting guidance in previous reporting guidelines, handbooks and critical appraisal tools when developing or updating any reporting guideline. Generation of a comprehensive item bank through review and mapping of the literature facilitates identification of missing items, and those needing modification, which may not otherwise be identified by the guideline development team or from other activities commonly used to develop

reporting guidelines (e.g. Delphi exercise). Use of the item bank to frame discussion at guideline consensus meetings can also potentially help to mitigate the groupthink that can occur in such meetings. We encourage reporting guideline developers to start a review of reporting guidance by searching the publicly available library maintained by the EQUATOR Network, along with other key sources providing reporting guidance for the study design of interest. Developers should consider including in the review tools designed to appraise the reporting quality of published studies. Doing so can help ensure that what is recommended for reporting in the reporting guideline aligns with what is expected to have been reported by developers of the critical appraisal tool (73). Developers should also document the findings of the literature review transparently so that users can understand clearly what materials and content informed the final reporting guideline developed.

Despite evidence of improved reporting of SRs over time (21), an increasing body of literature suggests that adherence to PRISMA 2009 is suboptimal (22). In a synthesis of 23 studies evaluating the reporting quality of 2,382 SRs published after the PRISMA statement was disseminated, nine of the 27 PRISMA items were adhered to by fewer than two-thirds of the SRs (22). Poorly reported items included SR registration details or existence of a SR protocol, a full electronic search strategy, methods for assessing risk of bias in individual studies, and funding source for the SR. The item bank generated in this study was developed to ensure we started with a comprehensive list of items to consider for inclusion in the updated PRISMA statement, not to address the issue of poor adherence to PRISMA. There is a risk that expanding PRISMA to include *all* items identified in our item bank will prove a greater barrier to adherence to PRISMA in the future, given the extra burden on authors. Therefore, additional work is needed to select items from the item bank that represent an optimal minimum set for authors reporting SRs and meta-analyses, which is informed by evidence that supports their reporting, expert consensus and user testing.

The items identified in this review subsequently formed the basis of a survey of systematic reviewers, methodologists and journal editors (conducted in July 2018, results forthcoming). Participants were invited to comment on each of the existing 27 items in the PRISMA 2009 checklist, indicating whether they preferred to maintain the item, modify the item, or remove the item from the checklist. Participants were also asked whether each potential new item proposed should be included in the updated statement, and if so, whether it should be included in the checklist or 'explanation and elaboration' paper. Additionally, survey respondents were given the opportunity to propose additional items throughout the survey. We discussed the findings of the survey at an in-person consensus meeting in September 2018. Development of the updated PRISMA statement (informed by the literature review, survey and meeting discussions) is ongoing. Once the statement has been updated, we also plan to use various strategies to increase adherence that have been used successfully when implementing other reporting guidelines (74).

5. Conclusion

We encourage others wishing to generate reporting guidelines for types of SRs and meta-analyses that fall outside the scope of PRISMA 2009 (e.g. SRs in disciplines other than health), or those wishing to update existing reporting guidelines for SRs, to make use of the item bank collated in this study. Doing so should reduce redundancy of effort and ensure that guideline developers start with a comprehensive list of items to consider for inclusion. We found this to be a valuable first step in the update of the PRISMA statement for SRs and meta-analyses and advise developers of reporting guidelines for other study designs to consider adopting a comparable, rigorous approach to item generation.

Declarations

Competing Interests

MJP and DM are Editorial Board members for the *Journal* but had no involvement in the peer review process or decision to publish. No other authors have any competing interests in relation to the submitted work.

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Author Contributions

All authors declare to meet the ICMJE conditions for authorship. MJP and DM conceived the study design. All authors provided input into the study design and suggested sources for inclusion in the review. MJP collected data and classified reporting items. MJP wrote the first draft of the article. All authors contributed to revisions of the article. All authors approved the final version of the submitted article.

Data Availability

All data are available within the paper and on the Open Science Framework at https://osf.io/kbj6v/.

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